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Corneal Tomographic and Biomechanical Factors Associated with Keratoconus Progression

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OBJECTIVES

To determine corneal biomechanical and tomographical factors associated with keratoconus progression.

METHODS AND MATERIALS

- Data of 84 keratoconus patients who had at least 1 year of follow-up with at least 3 concurrently performed separate examinations of Ocular response analyzer (ORA) and Pentacam were included in this study.
- Tomographically better eye was chosen as the study eye.
- Progression was defined as the presence of progressive change in two consecutive visits for any single parameter ≥95% CI (uninterrupted green line) or two parameters ≥80% CI (interrupted green line) for the normal population as assessed by the Belin ABCD Keratoconus progression display (Figure 1).
- Analyzed Pentacam parameters were Kmax, minimum pachymetry, apex pachymetry, and Belin Ambrosio Enhanced Ectasia Display Final D value.
- Corneal hysteresis (CH) and corneal resistance factor (CRF) along with the waveform parameters from ORA were analyzed.
- Factors associated with keratoconus progression were evaluated using t-tests and stepwise logistic regression.

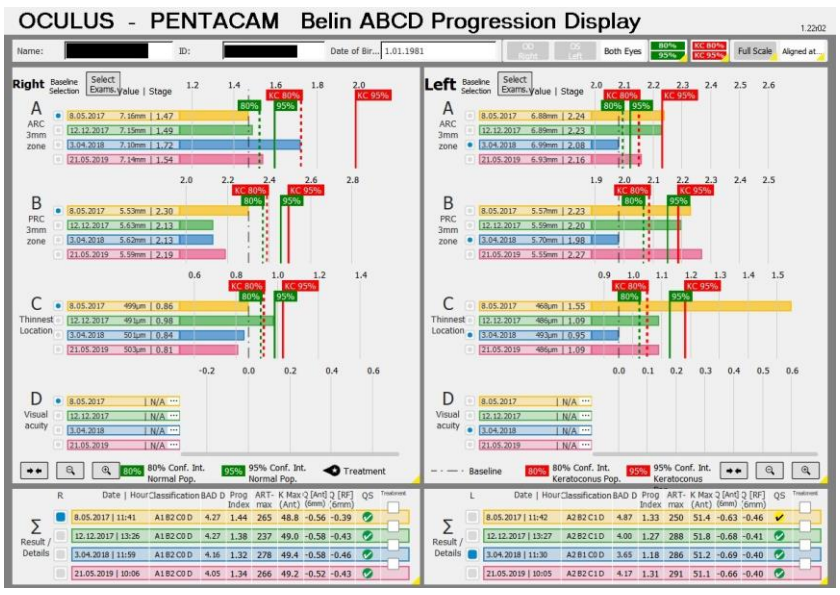


Figure 1. This diagram is taken from the Pentacam device. Progression was defined in the presence of any single parameter crossing the 95% CI (uninterrupted green line) or any two parameters crossing the 80% CI (interrupted green line).

RESULTS

- There were 44 (mean age: 29.3± years, female: 26) and 40 (mean age: 30.2± years, female: 19) patients in the progressing and non-progressing groups, respectively.
- Although Pentacam parameters along with CH and CRF were similar between the two groups, ORA waveform parameters derived from the second applanation signal (uslope2, slew2, aspect2, mslew2, dive2, h2) were statistically significantly higher in the non-progressing group (Table 1, all p< 0.05).

	Non-progressing Mean (SE)	Progressing Mean (SE)	p value
CRF	6.71 (0.32)	6.55 (0.31)	0.71
CH	7.91 (0.23)	7.51 (0.23)	0.23
aindex	9.77 (0.71)	9.36 (0.17)	0.1
bindex	9.4 (0.24)	9.14 (0.24)	0.44
p1area	2935.22 (159.84)	2790.31 (155.95)	0.53
p2area	2417.03 (164.61)	2163.23 (160.6)	0.28
aspect1	16.05 (0.78)	14.9 (0.76)	0.3
aspect2	18.34 (1.15)	13.39 (1.12)	**0.003**
uslope1	43.88 (2.56)	40.3 (2.5)	0.33
uslope2	60.9 (4.06)	39.06 (3.96)	**<0.001**
dslope1	27.29 (1.45)	25.24 (1.41)	0.32
dslope2	28.49 (2.04)	23.58 (1.99)	0.09
w1	20.65 (0.6)	20.61 (0.57)	0.96
w2	19.12 (0.93)	20.81 (0.91)	0.2
h1	319.35 (14.81)	299.05 (14.45)	0.34
h2	308.61 (16)	252.57 (15.61)	**0.02**
dive1	290.72 (17.2)	246.18 (16.78)	0.07
dive2	280.02 (16.85)	216.66 (16.44)	**0.01**
path1	21.95 (0.82)	22.09 (0.8)	0.91
path2	26.05 (1.15)	24.67 (1.12)	0.4
mslew1	73.61 (3.5)	71.03 (3.41)	0.61
mslew2	92.09 (4.85)	71.22 (4.73)	**0.003**
slew1	44.9 (2.64)	42.4 (2.58)	0.51
slew2	62.37 (3.4)	42 (3.87)	**0.001**

Table 1. Comparison of Pentacam and ORA parameters between progressing and non-progressing groups. Bold indicates statistical significance at $p < 0.05$ level.

- A 10 unit increase in uslope2 reduced the likelihood of keratoconus progression by approximately 30% in the logistic regression analysis (β= 0.707, p=0.001, model r^2=0.27).

LIMITATIONS

- The use of normal population may have led to a relatively high progression rate. If we have used the keratoconus population, it would have resulted in a smaller rate of progression.
- In this study, we did not use the best corrected visual acuity (criteria D). Using also criteria D may show us more accurate progression analysis.

CONCLUSION

ORA waveform parameters derived from the second applanation signal were significantly different in progressing eyes.

Parameters derived from the second applanation signal of ORA may be predictive of keratoconus progression.